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A comparative review of the fisheries resource management systems in New Zealand and in the European Union

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Abstract – This review aims at comparing the fisheries management systems existing in New Zealand and in the European Union. The involvement of stakeholders at all stages of the management process is generally more transparent and better established in New Zealand than in the EU. Both systems aim at achieving an adequate balance between sustainability and utilisation and consider the precautionary approach as a founding principle. The social objectives are probably more explicit in the EU management system. In New Zealand, B_{MSY} is a legal management target for all stocks in the quota management system (QMS), but management strategies were poorly explicit until most recently. In the EU, there have not been any legal management targets or strategies until 1999. Since 1999, a number of multi-annual recovery and management plans have been established, including both management targets and strategies. Both management systems include conservation and access regulation measures. The EU management measures aim at regulating fisheries outputs and inputs, and discarding is tolerated. New Zealand management is almost exclusively output-based, and discarding practices are banned. In the EU, while individual quotas (IQs) are implicit in several countries, there is no consistent pattern across Member States for allocating TACs. In New Zealand, individual transferable quotas (ITQs) are implemented, and some flexibility in catch-quota balancing is provided by a carry-over allowance and the payment of a landing tax, the deemed value, for every fish landed above quota. If rights-based management were introduced in the EU based on, e.g., the New Zealand model, we suggest that concentration rules be set in accordance with the social objectives of the Common Fisheries Policy, and also that the deemed value should be set based on science and economics.

Key words: Fisheries / Total allowable catches / Rights-based management / Quota / Atlantic Ocean / Pacific Ocean

Résumé – Cette analyse vise à comparer les systèmes de gestion des ressources halieutiques actuellement en place en Nouvelle-Zélande et dans l'Union européenne. La participation des professionnels de la pêche à tous les niveaux du processus de gestion en Nouvelle-Zélande est généralement plus transparente et mieux établie que dans l'Union européenne. Les deux systèmes, pour lesquels l'approche de précaution est l'un des principes fondateurs, visent à atteindre un juste équilibre entre conservation et utilisation des ressources halieutiques. Les objectifs sociaux sont sans doute plus explicites dans le système de gestion européen. En Nouvelle-Zélande, la biomasse à l'équilibre, B_{MSY}, est la cible de gestion légale pour tous les stocks soumis à quotas, mais les stratégies de gestion étaient peu explicites jusque très récemment. Dans l'Union européenne, il n'y avait ni cible, ni stratégie de gestion jusqu'à 1999. Depuis 1999, plusieurs plans de gestion et de restauration pluriannuels ont été développés, incluant à la fois des cibles et des stratégies de gestion. Les deux systèmes de gestion comprennent des mesures de conservation et de régulation de l'accès aux ressources halieutiques. Les mesures de gestion européennes visent à restreindre les variables d'entrée et de sortie du système pêche, et les rejets sont tolérés. La gestion néo-zélandaise est axée quasi-exclusivement sur les variables de sortie, et les rejets sont interdits. Dans l'Union européenne, les quotas individuels sont implicites dans plusieurs pays, mais les modes d'allocation varient d'un Etat membre à l'autre. En Nouvelle-Zélande, un système de quotas individuels transférables (QIT) est en place, et une certaine flexibilité dans l'équilibrage captures-quotas est apportée par la possibilité de reporter une partie des captures sur le quota de l'année suivante, et aussi par le paiement d'une taxe, « *deemed value* », appliquée aux débarquements hors-quotas. Si une gestion centrée sur les droits d'accès était introduite dans l'Union européenne, suivant le modèle néo-zélandais, par exemple, nous suggérons que des règles de concentration soient établies en accord avec les objectifs sociaux de la Politique Commune des Pêches, et aussi que la taxe soit calculée sur la base de résultats scientifiques et économiques.

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1 Introduction

Fisheries management systems worldwide have evolved towards a variety of objectives, strategies and processes. Comparing such systems may be enlightening in the context of fisheries management, as management agencies learn from each other's successes or failures.

One interesting aspect, when comparing the fishery management systems of the European Union and of New Zealand, is that they are probably some of the most contrasted systems of developed countries. The first set of contrasts lies in the basic geography of these nations. There is an obvious scale difference between New Zealand (0.3 million km^2, 4 million inhabitants and a centralised governance) and the EU (4.3 million km^2, 500 million inhabitants and a variety of countries). While both the EU and New Zealand have very wide exclusive economic zones (EEZs), the combined EU zone amounts to 25 million km^2 (making it larger than the United States' zone, the largest of any single country), while New Zealand's EEZ amounts to 4.1 million km^2 (i.e. fifteen times the country's land area and the fifth largest in the world).

The second set of contrasts resides in their respective fisheries economy. A striking difference between the EU and New Zealand is that while the EU is the first importing nation of fishery products in the world, New Zealand's economy is clearly orientated towards the exportation of these products.

Finally, there is a general perception that New Zealand, unlike the EU, has generally achieved a satisfactory balance between the conservation and the utilisation of its fisheries resources. Thus, New Zealand's fisheries management is often positively qualified by experts as: flexible, transparent, and allowing for broad involvement of stakeholders, while terms with a rather negative connotation have been commonly used to characterize the EU system, including: command and control, rigid, highly subsidised, poorly performing (e.g. characterized by depleted stocks and over-capacity), non-transparent and poorly participative (Holden 1994; Hilborn 2004; Mesnil 2008). More interestingly perhaps, the technical basis of both fisheries management systems is conceptually opposed. Typical contrasts between New Zealand's and EU's management would include: profit-maximising versus risk-reduction strategies; economic versus administrative approaches; output-based versus input-based measures and instruments.

In this investigation, we have compared the EU and the New Zealand fisheries management systems.

To keep the review within tractable boundaries, we have compared the New Zealand fleets with only those EU fleets operating in the North-East Atlantic (including the North Sea, the Channel, Western Scotland, the Celtic Sea and the Bay of Biscay). This means, in particular that fisheries from, e.g., the Baltic Sea and the Mediterranean Sea, but also long-distance fisheries, have not been considered in the context of this investigation.

Also, to restrict somehow the scope of our analysis to the most salient management features, we have focused on fisheries resource conservation and access regulation issues. This selection implies in particular that we have not considered social and equity aspects of fisheries management. It is also understood that this comparative review addresses conventional fisheries management aspects, and not ecosystem management measures such as, e.g., marine protected areas (MPA). This is not to say, however, that this study is not expected to bring any elements to the debate on the ecosystem approach to fisheries. To the contrary, it is our and others belief that implementing effective conventional management measures is an essential step towards the ecosystem approach to fisheries, especially if one accepts that human beings are part of the ecosystem (Hilborn 2004; Grafton et al. 2006).

To review the EU and the New Zealand fisheries resource management systems, we have used several keys, and these are structuring to a large extent the present study: (1) historical background, (2) management processes, (3) management principles and objectives, (4) management strategies, (5) management measures, (6) conservation performances and, (7) perspectives.

2 Historical background

2.1 Fisheries resource-based management in New Zealand

When Europeans started to settle in New Zealand in the early ninetieth century, Maori had already implemented a system of customary fishing rights. Before the Second World War, the British Government adopted a number of fisheries management measures including area/seasonal closures, gear restrictions and licenses. In the sixties, the Government provided incentives for modernization of fishing vessels, resulting in a dramatic development of the New Zealand fishing fleet.

In 1977, New Zealand extended its EEZ to 200 nautical miles, making it the fifth largest in the world. In order to promote fisheries profitability, the Government implemented on 1 October 1986 a quota management system (QMS), based on individual transferable quotas (ITQs).

A major challenge to the implementation of the QMS was its inconsistency with the Treaty of Waitangi, signed in 1840 by Maori and the British Crown. The Treaty, in particular, guaranteed Maori *"full exclusive and undisturbed possession of their lands and estates, forests, fisheries"*. Maori protested unsuccessfully against the disrespect of their fishing rights over 140 years. An agreement, the Deed of Settlement, was eventually reached in September 1992. The Settlement secured Maori 20% of the quota of any new QMS species and 50% of the shares of Sealord, the most important fishing company at that time. The Settlement was incorporated in the new Fisheries Act in 1996.

The Fisheries Act was amended in 1998 and 1999, with the aim of improving the flexibility of the catch-quota balancing regime. In 2007, there were 96 species and 629 stocks in the QMS.

More detailed information on the history of New Zealand fisheries management may be found in Hersoug (2002), Johnson and Haworth (2004), Yandle and Dewees (2008).

2.2 Fisheries resource-based management in the European Union

The roots of the CFP lie in the original EU (formerly European Community) Treaties signed in 1957, which envisaged a common policy for fisheries.

The basic principle of the earliest common agreement on fisheries policy, reached in 1970, was that the European Community fishermen should have equal access to Member States' water sources. As a natural and mobile resource, fish were deemed to be the common property of all EU Member States. In 1976, in line with international agreements, exclusive fishing grounds were extended from 12 to 200 miles around the EU coast, and it was also decided that the European Community was best placed to manage access to fisheries. Seven years of negotiations followed before the first CFP was eventually agreed in 1983.

The CFP has since been reformed twice, in 1992 and 2002. In both instances, reforms aimed to preserve declining fish stocks. The late 1980s saw the fishing industry becoming a victim of its own success: high prices led the industry to overinvest, leading to overfishing. Some claimed this was exacerbated by systems of EU grants to the fishing industry, which were seen as a good way to promote regional development.

The 2002 review withdrew the grants allocated to build new boats and provided incentives for decommissioning existing vessels. In addition, recovery plans were adopted in relation to specific threatened species, while management plans were implemented for other stocks.

In addition, a Compliance Scoreboard for Member States was to be published and a code of conduct for responsible fishing developed. The new CFP came into force on 1 January 2003.

3 Management processes

In New Zealand and the EU, advisory processes feeding into decision-making include formalised science and policy steps with various opportunities for input on economic, operational, environmental and social issues. Processes in both regimes are dynamic, with changes occurring even as this report is being written. Consequently, although we describe here an amount of detail, our main emphasis is on the major process components to allow gross comparison.

The New Zealand system is relatively straightforward. In comparison, the EU system is more variable, depending on the focus of operation and involvement of international commissions or non-EU governments. For simplicity, we will describe the EU system from the narrow focus of those areas subject solely to EU management and for which advice is provided by the International Council for the Exploration of the Sea (ICES). For the purposes of comparison, we also restrict our scope to a consideration of the main processes involved in setting quotas or in changing regulations. A comparison of other processes – for example, as related to environmental issues or ecosystem management – is therefore outside the scope of this section.

3.1 The New Zealand system

3.1.1 Science

Science processes in New Zealand are well established. The Ministry of Fisheries is responsible for managing and chairing all stock assessment, aquatic environment and research planning groups. The many fish-stock assessment working groups (FAWGs) meet over a period of time, with daily meetings spread out over weeks or months to allow contracted work to be undertaken and for work in response to FAWG feedback. The FAWGs culminate in an Assessment Plenary meeting in early May which serves a limited review function and provides final input to report preparation. The Ministry of Fisheries is responsible for producing annual Plenary Reports, which include sections on all stocks, whether or not they have been considered that year.

Of the 629 stocks (96 species) in the QMS, only hoki (*Macruronus novazelandiae*) is considered annually. Most of the commercially-important stocks are considered every 2–3 years, and the majority of stocks are considered on a less frequent basis. Many stocks have not been considered for a decade or more.

In addition to managing and chairing FAWGs, the Ministry of Fisheries is responsible for contracting and managing work to feed into them. Work is contracted following associated research planning groups (RPGs) that provide detailed input to processes leading to the Ministry's budget requests and allocations. When the Ministry receives an annual budget, part of the commitment is specifically allocated for research. That research commitment is developed from the identified and budgeted individual projects. The commitment, including the project details, is approved by the Minister. As a matter of administrative policy, consultation is required in the development of the research plans and budget and, if variations from the plan are to be made, further consultation is required between the Ministry and the New Zealand Seafood Industry Council Ltd (SeaFIC). New Zealand has a cost-recovery regime whereby ITQ holders are levied to pay for project-specific costs based on an attribution model (see Stokes et al. 2006 for further details).

Research providers such as NIWA (The National Institute of Water and Atmospheric Science), the Ministry of Fisheries, scientists and managers, SeaFIC, industry representatives and sometimes fishers, occasionally NGOs and others, participate in RPGs, FAWGs and Plenary processes. The science processes in New Zealand are strong and robust, with good access by and inclusion of interested parties. One flaw is the restricted capacity and funding that lead to some FAWG having insufficiently wide technical input to ensure good review and quality control. There is general recognition that these national capacity limitations could be offset by more frequent external reviews.

It is important to note that the various science groups and the final science advisory committee are open to non-scientists. Despite some potentially contentious issues, all FAWG and Plenary reports are consensual. This is not to say that the processes are free of contention. The majority of FAWG are straightforward and non-contentious, but some (e.g., Deepwater FAWG) provide a challenge. Challenges arise particularly when stock assessments and data create an uncertain technical basis for objective analysis and commentary and when scientific reports feeding into decision-making processes may have a marked effect on sustainability or utilisation outcomes.

The Fisheries Act provides an obligation on the Minister of Fisheries (advised by the Ministry) to alter TACs to ensure that stocks are likely to be at or above, or move towards, a level that can produce the maximum sustainable yield. This obligation has to be based on best available information and take account of uncertainty in information, and decisions must balance the dual purpose of providing for utilisation whilst ensuring sustainability. Considerable case law has provided guidance as to how decisions need to be made. Unlike in many other jurisdictions, there is neither policy nor law that dictates more explicit standards or reference points that can guide scientific processes and outputs.

Since 2006, the Ministry of Fisheries has been developing a range of "standards" to guide the provision of advice and decision-making. The set of standards being developed is broad. Of most interest to this discussion is the development of harvest strategy standards (HSSs), which have been established in October 2008 (New Zealand Ministry of Fisheries 2008). For many years, the Assessment Plenary report included a "Guide to Biological reference Points". The guide provided background to explain the outputs expected from FAWGs and to guide FAWGs on the types of outputs required for providing advice. Although produced regularly for many years (including in 2008), the guide has no legal or policy status. The intention of the Ministry in developing HSSs is to replace the guide with an agreed and clear policy to guide FAWGs and advisory processes concerning TAC-setting. This approach to standards is in line with developments in other jurisdictions (notably in the USA, international commissions, etc.).

The Assessment Plenary reports comment on stock status and provide guideposts for management, often based on the old and very general Guide for Biological Reference Points or, increasingly, on stock-specific requirements to help decision-making. In the past it was common for FAWGs simply to produce a few standardised yield estimates, each calculated under a wide range of assumptions that might be used in developing advice on TACs. Increasingly, for many stocks more sophisticated approaches are used. There is generally less model-uncertainty portrayed than in the past, although considerable sensitivity testing takes place and is taken into account. Short and medium-term projections are more prevalent than in the past, and decision tables are commonly provided.

There is no standardised output across stocks or even through time for a given stock; this could change with the adoption of HSS. In principle, the approach taken is highly responsive to management needs and able to provide best available information on a stock-by-stock basis, rather than constrained by standardised approaches. The approach is in principle good to feed into a sensitive and responsive active management framework in a single country, but would not aid mass TAC-setting on an annual basis in the multi-national context of the EU.

3.1.2 Operational policy

The Ministry of Fisheries has separate groups dealing with strategic policy development and operational policy. The Operations group deals with a range of processes, including provision of advice on regulatory controls and TAC- setting. The latter takes place twice a year under the so-called Sustainability Round. The main Sustainability Round follows the May Assessment Plenary and culminates in final advice to the Minister in time for decisions in September (and the start of the fishing year which, for most New Zealand stocks, is on the first of October).

The Assessment Plenary report is a major input to the Operations group. Other inputs come in the form of internal and external discussions; contracted or other relevant papers on environmental, economic and other matters; managers' deliberations with stakeholders, etc. In June, the Operations group develops an initial position paper (IPP) covering a number of statutorily required issues and providing initial options for TAC changes and other controls. In addition to providing advice on TAC-setting, there is a requirement to provide advice on how TACs should be allocated to customary (Maori), recreational and commercial sectors (see Gibbs and Stokes 2006). There is no law or policy to guide this advice. Further, once a TAC is set, it needs to be defended. The IPP will therefore typically also address a range of other issues, including, for example, deemed value[1] setting. Traditionally, IPPs were developed by the Ministry in isolation. Increasingly, discussion with stakeholders occurs even at this early stage in the process, with considerable recognised benefit from early engagement.

The IPP is also made publicly available, and submissions are sought on all aspects. This is a requirement under the Fisheries Act. Administrative and case law guides consultation processes, which are required to be fair and open-minded. On sustainability round IPP, it is common for submissions to be made by customary, recreational, industry and environmental groups as well as by individuals. The number of submissions varies greatly, depending on the issue at hand. Once submissions are received, the Ministry is required to analyse and summarise submissions (sometimes using external analysts, depending on scope and issues) and to develop a final advice paper (FAP) for the Minister; then, the FAP is released, usually alongside the Minister's decision letter that explains decisions made.

The process is complex, defined in law and subject to many statutory constraints. Overall, although cumbersome, it allows for considerable stakeholder involvement. Although stakeholders may not always be satisfied with outcomes, there is a general recognition that the system has integrity. Where failings have been found and tested legally, case law has been developed such that the system is now generally well understood.

Finally, a major debate has been taking place for many years as to the respective roles of Government and stakeholders in fishery management. When the Fisheries Act was passed into law in 1996 and amendments were made in 1999, there was expectation that management responsibility would pass to ITQ holders ("devolution"). The amended Act in particular provided for stakeholder-led fishery planning. At the time of writing, the industry's expectation has not been met.

[1] As explained later in this report, the deemed value is a tax applicable to any kg of fish landed above quota.

3.1.3 Decision-making

Decision-making under the Fisheries Act is the prerogative of the Minister of Fisheries but can, in limited areas, be delegated to the chief executive of the Ministry of Fisheries. Decisions on TACs[2], allocation, deemed values and the majority of regulations are always made by the Minister.

Consider the process of setting and allocating TAC. Decisions are made before the start of the fishing year. For the vast majority of the New Zealand stocks, the fishing year starts on the 1st of October. For the remaining TAC stocks, the fishing year starts on 1 April (southern blue whiting, rock lobster, scallop, deepwater crabs, horse mussels, surf clams and sea cucumber) or, in the case of one eel stock, the 1st of February. After setting a TAC, an allocation decision also needs to be made, specifying allowances for (1) the customary fishers, (2) recreational fishers and (3) other sources of fishing mortality (e.g., illegal fishing). The TAC allocation is not based on any clear scientific or policy basis. After these allowances are made, the remaining share is allocated to the commercial fishing sector, and is referred to as TACC (total allowable commercial catch). It corresponds conceptually to the EU TAC. Approximately 40 species have QMS allowances for customary Maori fishers and there is a similar number for recreational fishers.

When confronted with a Sustainability Round FAP, the Minister is required to make a number of difficult decisions based on what is often uncertain information. Nevertheless, under the Fisheries Act, poor information is not a reason to delay decisions that are required by law. All that is required is that the Minister receive fair and comprehensive advice and that a decision attempting to balance the dual objectives of the Act be made based on the best available information (given reasonable costs and time to collect it). A feature of the system is that decisions are usually explained by way of a Decision Letter. Such letters are not always compelling and sometimes reveal the difficulty of making decisions in the face of uncertainty, but at least there is feedback to stakeholders who have often expended considerable cost participating in the processes and in writing submissions.

The quality of decision-making, as ever, can be no better than the quality of the advice. Faults have been found and tested over the years in decision-making and advisory processes but there is generally acceptance of decisions and continuing stakeholder involvement. The Fisheries Act 1996 provides the Minister with considerable discretion. Legal reviews can only be made on the basis of process and reasonableness/rationality, not on the substance of the decision.

3.2 The EU system

3.2.1 Science

As in New Zealand, science processes are well established. The European Commission is the main client commission of the International Council for the Exploration of the Sea (ICES) and agrees to standing and specific requests that are provided to relevant Advisory Committee(s) and Expert Groups. For the purposes of this section we are concerned only with the Advisory Committee on Fisheries Management (ACFM), now superseded by the overarching Advisory Committee (ACOM), and stock assessment working groups (SAWGs) reporting until 2008 to ACFM and since to ACOM. For simplicity, given the recent change of ICES' advisory structure, we will here refer to ACFM and the structure as it has existed until the time of writing.

In ICES, the SAWGs meet for concentrated periods of 5–10 days at a time to undertake annual assessments for all stocks and provide responses to requests for advice. There is little or no inter-sessional work. SAWGs reports are provided to ACFM which has a brief but intensive period of technical review process before a week-long meeting at which advice is formulated and reports prepared (http://www.ices.dk/products/icesadvice.asp). ACFM meets twice a year for extended periods.

ICES professional staff are responsible for managing and supporting SAWGs and ACFM. Chairs of SAWGs are typically drawn from government laboratories of ICES' Member States whilst the independent Chair of ACFM (and now ACOM) is appointed by the ICES' Council and paid on a contractual basis by ICES. Work during SAWGs is carried out principally by employees of government laboratories. Coordination does take place for major inputs (for example, international resource surveys) but work programmes generally are developed and managed at individual laboratories level. To the authors' knowledge there is no cost recovery from industry for research or monitoring costs. Indeed, national governments and the European Commission provide substantial funding for monitoring, assessment and advisory work.

SAWGs are attended by scientists from government laboratories and occasional academic or other expert colleagues, typically from government or quasi-governmental organisations from non-member countries. There is no provision in SAWGs for participation by stakeholders. In addition to SAWGs, ICES Expert Groups include a wide range of *Ad hoc* and Study Groups and coordinating groups. Amongst the wide range of Expert Groups, specific ones are dedicated to methodological development and discussion.

ICES arranges external reviews of stock assessments as part of the advisory processes. In recent years, increasing use has been made of external reviewers. Given the wide range of scientists at meetings, coordination between laboratories, integration of scientists between countries on EU-funded projects, and other mechanisms, even without external review there is a strong culture of quality control in the ICES system. The methodologically-oriented groups also serve the purpose of facilitating exposure to and possible adoption of new approaches.

Although the participation to SAWGs is exclusively restricted to scientists, there has been, in recent years, an attempt within ICES to allow the stakeholders to consider the outcome of SAWGs' work prior to ACFM review and formulation of advice, and to participate, as observers to ACFM and now ACOM. Stakeholder review has occurred, for example,

[2] However, with regard to international stocks and fisheries, TAC decisions are taken under the auspices of international management agencies such as CCAMLR (toothfish) or CCSBT (southern bluefin tuna).

through separate commissioning of reviews by the North Sea Commission and the setting-up of external technical review groups prior to ACFM. In addition, when formulating advice to the Council of Ministers (below), the Commission is required to take advice from its own scientific, technical and economics committee on fisheries (STECF); although drawn from scientists and economists from a subset of the ICES community, the STECF does offer a further post-ACFM technical review and advisory function.

ICES has for a long time provided annual advice on catch limits for all stocks, using a standardised approach. As far back as the 1980s and through the 1990s, there was constant debate within ICES, and nationally within Member States, as to what form the advice should take to best inform management, and an incremental change was made in SAWGs and ACFM. In the mid-to-late 1990s, ICES was at the forefront of trying to implement "a precautionary approach". This caused some difficulty, given ICES' scientific rather than decision-making role and the lack of clear management targets from decision-makers. In response to the absence of clear guidance, ICES developed its own framework of reference points and structures to guide the provision of advice. Although not always welcomed by clients, this led to a standardized frame of reference for SAWGs to work in and for ACFM to use in formulating advice. It also led to increased consideration of harvest strategies by the European Commission and other ICES Member States and to the adoption of agreed strategies for a number of stocks.

The important point for our purposes is that ICES advisory framework is standardised and consistently applied and incorporates generally or by management agreement precautionary management elements. Overall, the outputs from ICES analyses are appropriate for a large-scale annual TAC-setting exercise.

3.2.2 Operational policy

After scientific advice has been formulated by ICES, all EU members operate differently at the national level. The common feature is that all need to receive an interpretation of ICES' advice and formulate responses and positions that can be considered in European Commission Working Groups and taken to the recently established Regional Advisory Committees (RAC). The Commission is ultimately responsible for developing proposals for the Council of Fisheries Ministers based on the consideration of, e.g. advice provided by ICES and STECF, input from Member States and RACs, and pre-agreed harvest strategies.

Fisheries in Europe are managed under the Common Fisheries Policy (CFP) and relevant Regulations. Until the reform of the CFP in 2002 (operational from 1 January 2003), the general approach to fisheries management in the EU could best be described as *ad hoc*, with a short-term focus and variable weight in decisions given to sustainability, social and utilisation objectives. This led to an uncertain environment for the fishing industry as well as to poor stock conservation performance. The reformed CFP has placed much greater weight on meeting long-term objectives and using pre-agreed strategies and targets to meet those objectives. This approach is more consistent with the form of advice developed by ICES.

As part of the CFP reforms, RACs were created in 2004 to strengthen dialogue with stakeholders, especially the fishing industry. RACs are made-up of fishers, scientists and other parties whose interests are affected by the CFP. Representatives of the Commission and of national administrations from any of the Member States concerned may also participate in the RACs. The aim of RACs is to allow people who do not have a direct input in the CFP at the European level to participate at the regional or local level. The Commission may consult the RACs on proposals for measures such as multi-annual recovery or management plans. The RACs may also inform the Commission or the Member States of problems relating to the implementation of CFP rules and formulate recommendations. RACs have been or are being created in relation to seven areas/fisheries: Baltic Sea, Mediterranean Sea, North Sea, Northwestern waters, Southwestern waters, Pelagic stocks and Distant-Water fisheries. Plans currently being developed by the "Celtic Sea Management Advisory Committee" of the Pelagic RAC in relation to Celtic Sea herring and Western horse mackerel are real examples of the RACs' co-management activities.

3.2.3 Decision-making

Since the inception of the CFP in 1983, the EU has vested authority for managing fisheries in the waters of its jurisdiction, and of fisheries in international waters operated by EU vessels. The Council is considered the primary EU institution because it has the power to adopt legislation. The Council consists of representatives of the Member States in their area of competence. For instance, the Council includes generally the Ministers of Fisheries when making decisions on TACs. The powers of the Council are: to take decisions based on the Commission's proposals for legislation, to coordinate the economic policies of the Member States and also, possibly, to delegate some responsibilities to the Commission.

With regard to fisheries management, it has been the entire responsibility of the EU Council of Ministers to take decisions on TACs and national quotas, technical measures and fishing effort restrictions for the fisheries shared by several Member States. However, there are cases where the EU shares, or delegates, management. For straddling and widespread stocks, decisions are generally taken in accord with other countries (e.g., blue whiting) or within the framework of specific management agencies (e.g., Atlantic albacore tuna is managed through ICCAT). By contrast, the species for which exploitation is spatially limited (e.g., scallops) are generally subject to national management. TACs are set by the European Council every year for most of the stocks. The TACs are decided at the end of each year and come into force the following year on the 1st of January. TAC decisions have typically been based on scientific advice, mainly delivered by ICES, but also on short-term socio-economic considerations. For heavily exploited stocks, this has often resulted in the agreed TAC being a compromise between the catch options advocated by scientific advisors and the *status quo*. The overall agreed TAC is then divided between Member States based on a fixed allocation key (principle of "relative stability"), modified by the "Hague Preferences" (Holden 1994). However, exchanges of national quotas between Member States are authorised. An area where the EU does not take

responsibility for is the allocation of national quotas to individual fishers.

4 Management objectives and principles

4.1 Common overarching management objectives and principles

Management objectives and principles have been established for both the New Zealand and the EU fisheries, respectively under the legal frameworks of the Fisheries Act 1996 (Anonymous 2005) and of the Common Fisheries Policy 2002 (EC 2002a).

The overarching objectives of both management agencies are similar: to prevent fish stocks from being overexploited and to avoid that the pressure of fishing activities targeting certain stocks is jeopardising the reproductive capacity of the stocks concerned or putting them at risk of collapse. Both agencies also include, to different extents and details, biological sustainability, socio-economic, environmental and ecosystemic objectives.

Both the EU and the New Zealand founding decrees express similar principles of good governance, although the New Zealand Fisheries Act 1996 is more explicit and detailed in this respect. The first principle explicitly requires the involvement of stakeholders in the decision-making processes. The second principle requires sound scientific advice in the decision-making processes for both management agencies. Finally, both the Common Fisheries Policy and the Fisheries Act 1996 make a similar reference to the precautionary approach principle.

4.2 Management targets

4.2.1 New Zealand fisheries

One outstanding feature of the Act (Sect. 13) is that it makes an explicit reference to MSY[3] (maximum sustainable yield) and to B_{MSY}[4] as a management target for most of the stocks regulated under the QMS. If a stock is below the target, the Minister is legally obliged to take corrective action to rebuild biomass to or above B_{MSY} (or a related target level). In New Zealand, the MSY concept in the context of management objectives is overall well accepted by managers and stakeholders. However, there are many stocks for which B_{MSY} cannot be estimated reliably. For those stocks, the Act does not provide clear guidance as to management targets. Such difficulties have, on some occasions, limited the applicability of the Act in the context of fisheries management, and amendments to the 1996 Fisheries Act have recently been recorded.

4.2.2 EU fisheries

The sustainability objectives set under the CFP differ from those established under the New Zealand Fisheries Act in that no explicit management targets are set for the EU fisheries. Until 1999, management targets were only set for a few shared stocks (e.g., tunas and Greenland halibut). In 1998, the broader implementation of quantifiable management targets for EU stocks followed ICES recommendations based on precautionary approach (PA) biological reference points. Since 1998, and until recently, ICES recommendations have been mainly based on four risk-adverse biological reference points, two related to spawning stock biomass levels (B_{lim}[5] and B_{pa}[6]), and two related to fishing mortality levels (F_{lim}[7] and F_{pa}[8]) (ICES 1998).

Between 1999 and 2004, the EU and other nations agreed on management plans for a few stocks. These plans established the B_{pa} as a legally-binding lower limit above which managers should seek to maintain stocks (Annex).

Since 2004, the EU has been putting forward a range of unilateral management and recovery plans for selected stocks. The targets specified in these plans were mainly based on spawning stock biomass (SSB), fishing mortality, or a combination of both (Annex). While for most of the stocks subject to a management or a recovery plan, the concepts underlying the management objectives built on the precautionary approach, other principles were also considered, including the MSY (Annex). It should be noted that these stocks, although very important economically, represent only a minority of the stocks managed by the EU. No management objectives have been identified for the stocks not listed in Annex.

There are ongoing developments in the EU aiming at incorporating fisheries management into an integrated maritime strategy. These developments will affect the definition of management objectives and targets. As far as management objectives are concerned, the issues to be debated will include the use of MSY-related targets but also and more importantly the shift from species-based objectives towards fleet-based and/or ecosystem-based objectives.

5 Management strategies

5.1 New Zealand fisheries

In New Zealand, management strategies are currently in a state of evolution, as a result of the inception of harvest strategy standards (HSSs) in October 2008 (New Zealand Ministry of Fisheries 2008). The main approaches to management in use prior to October 2008 are briefly described below.

- The *"constant catch"* approach. It is by far the most widely implemented (151 stocks). Catches are held constant unless there is evidence that a stock is declining below B_{MSY}. Initial estimates have usually been based on the concept of MSY.

[3] MSY is the largest *average* annual yield (catch) that can be produced over a prolonged period of time while maintaining the stock's productive capacity.

[4] B_{MSY} is the average stock biomass level corresponding to MSY.

[5] Level of spawning biomass above which stocks should be maintained, to prevent impaired recruitments.

[6] Level of perceived spawning biomass below which stocks should not drop to prevent the actual spawning biomass from dropping below B_{lim}

[7] Level of fishing mortality, which should not be exceeded to prevent unsustainable exploitation.

[8] Level of perceived fishing mortality that should not be exceeded to prevent the actual fishing mortality from exceeding F_{lim}

- The "*quantitative assessment*" approach. Managers are provided with quantitative estimates of biomass, stock status and sustainable yields, and their decisions usually build on the concepts of MSY (53 stocks).
- *Alternative strategies* have also been developed in relation to specific stocks for a variety of reasons. The Adaptive Management Programme (AMP) has been an example of collaboration between the New Zealand Government and the fishing industry and currently applies to 33 stocks. The AMP framework is typically applied to developing fisheries where the stock is thought to be above B_{MSY}, and involves the introduction of a range of management measures. While the particular measures introduced may vary from stock to stock, essentially they subject any significant increase of the TAC to additional stock monitoring measures. The ultimate aim of this approach is to provide a clear signal from the stock monitoring information to improve the assessment of stock status and estimates of sustainable yield.

Overall, New Zealand fisheries management strategies are still mostly based on *ad hoc*, single-stock analyses. First, the technical interactions between harvested stocks are generally ignored. Second, although ecosystemic objectives are part of the Fisheries Act 1996, these are not explicitly linked with the targets relevant to commercial species. Third, the interaction between commercial fishing, recreational fishing, customary fishing, and also the other human activities operating in the marine environment (e.g. aquaculture, cables, pollution), are poorly addressed. The recent adoption of Harvest Strategy Standards is expected to establish the clear, specific, and measurable statements of results required to achieve the management outcomes.

Another current direction in New Zealand is the development of fisheries plans, including explicit management strategies and objectives. The primary goal of fisheries plans is to relate management objectives to management strategies and measures, but also to the interventions and services required to achieve those objectives. Fisheries plans are or should be defined on a fishery basis (as opposed to a stock basis), and should embrace the activities of all sectors involved in these fisheries, as well as ecosystem interactions. Fisheries plans will describe how New Zealanders can get best value from their fisheries, within environmental limits, or standards, set by the Government. The Ministry of Fisheries intends to develop 26 fisheries plans. Three plans have already been developed experimentally (Southern blue whiting, Coromandel scallops and Foveaux Strait oyster fisheries) and seven were under development at the time of writing. There remains, however, a debate as to the ability of stakeholders to develop and lead fisheries plans.

5.2 EU fisheries

Until the 2002 reform of the CFP, management strategies were restricted to multi-lateral agreements between the EU and other fishing nations. The first multi-lateral agreements were signed during the period 1999-2002 in relation to some North Sea stocks and some widely distributed pelagic stocks. The objective set in these agreements was to manage the fisheries above B_{pa}. The strategy identified to achieve that target was simply to keep the fishing mortality below F_{pa}. Overall, the strategies established in the multi-lateral agreements were short-term, single-stock and did not build in formal harvest control rules (HCRs).

With the 2002 reform of the CFP, the approach of European fisheries management has shifted from a short-term, single-species approach to a longer-term, fishery- and ecosystem-based approach, building on multi-annual plans targeting not just one species but a group of inter-dependent species. Two types of multi-annual plans have been implemented based on the state of the stocks in question: (i) recovery plans to help rebuild stocks that are in danger of collapse; and (ii) management plans aimed to maintain the other stocks at safe biological levels. Within these plans, targets for the sustainable exploitation of stocks have been established with regard to population size and/or long-term yields, fishing mortality and stability of catches. In addition, if confronted to unforeseen circumstances, the Commission and Member States could take emergency measures should action be needed to protect fish stocks in the short term.

The first unilateral EU plans were established in 2004 in relation to the recovery of different stocks of cod and Northern hake (Annex). The novel aspect of these plans was their multi-annual character. While the management target was still B_{pa}, the plans recognised that achieving the target may take several years. The strategies aimed at a compromise between bringing the stocks to safe biological levels whilst maintaining the industry's ability to make plans for the future. For the cod stocks, the plan specified the rate (30%) at which the SSB should be increased inter-annually until the target is achieved. In addition, they also specified that the year-to-year variation of the TAC should not exceed 15%.

These first EU plans had three major weaknesses. First, they were still very much based on single-stock considerations. Second, the plans did not establish a formal HCR. In particular, no guidance was given as to how to manage stocks when they returned to safe biological limits. Finally, the recovery plans were not necessarily consistent with ICES' advice (e.g., North Sea cod).

New EU unilateral plans were developed between 2005 and 2008 (Annex). The targets established in the new plans did not necessarily build on biomass triggers or on the precautionary approach. However, most of these new plans included a formal HCR. For instance, in the case of North Sea haddock, saithe and herring, the HCRs would specify three possible levels of F depending on whether the perceived SSB as being below B_{lim}, between B_{lim} and B_{pa}, or above B_{pa}. Finally, some of the plans have dealt simultaneously with several stocks, caught within the same fishery (e.g. hake and Norway lobster in the Iberian Peninsula).

Because of the short time elapsed since their implementation, it is not possible to evaluate the performance of the most recently developed plans. In principle, and although their consistency with ICES advice has not always been evaluated, the new EU plans provide a better multi-annual framework for fisheries management than those developed before 2004. However, it has to be remembered that these plans apply only to a

Table 1. Non-compliance index (frequency of estimated catches exceeding TAC(C)) and non-compliance ratio (median of the ratio between estimated catches and TAC(C)), calculated over stocks and years, for different periods and for stocks subject or not to an analytical assessment.

Assessment	Period	Number of observations		Compliance index		Compliance ratio	
		EU	New Zealand	EU	New Zealand	EU	New Zealand
No	1987-91	117	692	0.32	0.11	0.85	0.51
	1992-96	188	652	0.30	0.16	0.87	0.68
	1997-01	239	865	0.15	0.25	0.73	0.69
	2002-06	334	1417	0.20	0.25	0.77	0.69
Yes	1987-91	120	95	0.48	0.28	0.99	0.89
	1992-96	132	103	0.38	0.31	0.91	0.93
	1997-01	134	105	0.42	0.38	0.94	0.97
	2002-06	135	123	0.47	0.43	0.99	0.99

minority of the EU stocks. Moreover, even fewer of these plans really account for the mixed nature of fisheries.

6 Management measures

6.1 Conservation measures

The aim of conservation measures (whether under conventional management or EAF) is to ensure a high level of productivity for fish stocks. Three types of tools may be considered in this category: (i) catch limits, (ii) fishing capacity and effort limits and (iii) a suite of technical measures. Catch, capacity and effort limits are intended to bind the overall fishing mortality to a level which does not impair the reproductive capacity of the harvested stocks. Fishing capacity and effort limitations usually apply to fleet size (e.g. number of vessels), fishing power (e.g., engine power, vessel length), and also the time spent fishing (e.g., days at sea). The main purpose of technical measures is to limit catches and discards of specific life stages (usually juvenile fish) and unwanted species and also to mitigate the adverse effects of fishing activities on the ecosystem. Technical measures may take the form of gear restrictions (e.g., minimum mesh size, minimum landing size, by-catch limits, and closed areas/seasons) and can play an important role in EAF.

Catch limits, also known as TACs and quotas, have traditionally been the main regulatory tools for both European and New Zealand fleets. Whereas technical measures, capacity limits (Anonymous 1990, 1996) and, more recently, days at sea restrictions, have been widely implemented by EU fisheries managers, such measures have only rarely been enforced in New Zealand, where the Ministry of Fisheries has almost exclusively opted for TAC-based management. Therefore, we will restrict our comparative exercise to the implementation of TAC as a fisheries resource conservation tool in the EU and in New Zealand.

Since the inception of the CFP in 1983, the EU, through the Council of Ministers, has regulated most of the commercially important stocks with TACs. A share of the TAC is allocated to each Member State based on a fixed allocation key. It is the Member States, and not the EU, who are responsible for the allocation of the national quota. Because TACs have mainly been set on a single-species basis, the balance between aggregated catches and TAC in mixed fisheries has repeatedly been at fault. In the EU it is illegal to exceed the TAC, but it is still tolerated to discard fish caught over quota. Therefore, one way to achieve catch-quota balancing has been to discard fish over quota, or even to underreport catches. It should however be stressed that, at the time of writing, an EU regulation is underway to restrict some forms of discarding. It is perhaps also worth noting that the EU has made significant steps towards the provision of mixed fisheries TACs (EC 2002b; EC 2006). This approach, which aims at improving the consistency between catches and TACs, has been supported by scientific works around the definition of métiers and the development of models allowing the integration of technical interactions in stock forecasts (Laurec et al. 1991; ICES 2003; Vinther et al. 2004).

In New Zealand, the first single-species TACs were set in 1983 for 7 deep-water stocks, within the frame of the 1983 Fisheries Act. These TAC were allotted to the nine companies harvesting these stocks at that time. In 1986, the quota management system (QMS) came into force and concerned a set of 17 inshore and 9 offshore species. Since 1996, the Government manages the QMS through the 1996 Fisheries Act. In 2007, there were 96 species (out of 130 commercial species) included in the TAC list, the objective being to include eventually most living marine organisms, including those with a commercial value and those whose sustainability is compromised by fishing activities, but excluding marine mammals. As detailed earlier, only a proportion of the TAC (TACC) is allocated to the commercial fishing sector. In New Zealand, except for a set of 11 species, all fish caught must be landed. Therefore, unlike in EU fisheries, discarding cannot be considered as an option to achieve catch-quota balancing. It is legal to land above quota, but a tax has to be paid for any kg of fish sold over-quota, and that is referred to as the *deemed value.*

Table 1 compares a non-compliance frequency (frequency of estimated catches above TAC or TACC) and a non-compliance ratio (median of the ratio between estimated catches and TAC or TACC) for all stocks regulated in EU and New Zealand waters. Note that, in the case of EU fisheries, the estimated catches include discards and misreported landings whenever available. To simplify notations in this section, we will refer to TAC(C) when referring to both the New Zealand TACC and the EU TAC. Note that the higher the non-compliance indices, the lower the compliance with TAC(C).

The TAC(C) compliance is always worse for the stocks subject to a stock assessment. This result suggests that the TAC(C) has been more restrictive for those stocks, but also that incentives for not exceeding that TAC(C) have not been sufficient. We will now consider those stocks subject to a stock assessment. The compliance reflected by both indices has deteriorated since 1991 for both the EU and New Zealand stocks. In 2002-2006, the frequency of annual catches exceeding TAC(C) has been of 43–47%. For both the EU and New Zealand, the catches are, on average, below but close to the TAC(C). The frequency of catches exceeding TAC(C) has always been lower for the New Zealand than for the EU fisheries.

6.2 Access regulations

The second set of fisheries management measures addresses the regulation of individual access to fish stocks. Assuming that a formal and clear allocation is a key to improved conservation, the aim here is to allocate the limited productive capacity of these stocks between fishing firms. This operation has itself two sides: (i) access: selecting firms (or vessels) which are allowed to fish a given stock (or group of stocks), and (ii) allocation: fixing the share each one is allowed to fish. The main access regulation measures applied in the fisheries worldwide are individual (catch) quota (IQ), individual effort quota (IEQ), fishing licences (or permits) and territorial user rights in fisheries (TURF).

In the case of the EU and New Zealand fisheries, the most important access regulation measure have been Individual Quotas, and we will restrict our comparative analysis to these instruments. Of particular importance are the individual transferable quotas (ITQs), which are considered by fisheries economists as a possible solution to the issue of excess capacity (Arnason 1990; Hersoug et al. 2000; Guyader and Thébaud 2001; Arnason 2007). In theory, ITQs create incentives for fishers to maximize the value of their catch and minimize harvest costs (Hentrich and Salomon 2006; Arnason 2007). They also create, in principle, economic incentives to avoid catch of species the fisher does not have quota for. Finally, in mixed fisheries, ITQs are expected to alleviate the discrepancy between the combined-stocks quota portfolios with actual species composition. Despite the flexibility brought about by ITQs, it is almost inevitable that the discrepancy will persist (Annala et al. 1991; Branch et al. 2006). A "plaster" is then needed to correct that mismatch, and that may take different forms depending on the country where the ITQs are implemented (Sanchirico et al. 2006).

Individual quotas, and even less individual transferable quotas, are not common practice in EU countries. However, this management measure seems to be increasingly applied for the management of the TAC constraints. The fact that TAC constraints become binding provides incentives to the administrations or the producer's organization to which global quotas are allocated to implement such a tool (Marchal 2006). Practical examples in different EU countries are described briefly below.

In France, since 1990, the French directorate for fisheries has been responsible for officially distributing national quotas of key stocks to Producers' Organizations (POs) since 1990. For other stocks however (e.g., flatfish), the national quota was distributed to the maritime districts to which fishers were registered over the period 1990-1998. Since 1999, the national quota of all key stocks has been allocated to POs. However, the management of vessels quotas within POs is not explicit.

In the UK, quotas are allocated administratively. However, a limited form of quotas transferability exists within a set of constraints (Valantin 2000). In 1995, the Government confirmed the responsibility of POs to accept allocations for all demersal species quotas (EC 2006). Recent amendments have recognised the POs as the representative bodies of the fishing industry in terms of quota management. The complexity in how exactly POs share quota amongst individual members reflects the diversity of potential distributional mechanisms (although all these will, as their basis, relate to some track/historical record that the POs have on file for each member). The three broad distributional types are: a pool system (i.e. monthly quota allocated to members); an individual quota system (i.e. shares allocated to each member based on fixed quota allocations) in addition to leasing of PO-controlled quota and a combination of both.

Before 1996, the Spanish quota was allocated to each fishermen association based on the number of vessels. Since 1996, the system has changed, and the administration only provides guidance as to how national quotas should be distributed. Therefore, any vessel with access rights could in principle catch any quantity of fish as long as the overall national quota is not exceeded. An adverse effect of this system is that it somehow encourages the "race for fish".

In general, the Danish fishery is regulated as an administrative control system enforced by using different types of management instruments to control and allocate the Danish TAC among Danish fishermen (or vessels). A quota ration system is applied for almost all demersal and industrial[9] stocks (Hoff and Frost 2007). From 2003, the individual transferable quota was applied for the herring stocks in the North Sea, Skagerrak and Kattegat, whereas IQ regulation continued for mackerel stocks.

The Netherlands are the only EU country to have had long practical experience with an ITQ system (Valantin 2000). ITQs were initially allocated to owners on the basis of vessel characteristics or past catches. Quota transfers have been legalized since 1985. To increase industry's involvement in fisheries management, responsibilities for managing quota allocations have been largely devolved to industry groups. In 1993, eight quota management (*Biesheuvel*) groups were established to manage the aggregate quota of their members.

In New Zealand, the Total Allowable Commercial Catches are distributed to quota holders as ITQ shares. On the first day of the fishing year[10], each ITQ (expressed as a percentage of the TACC) generates for each quota holder, and each

[9] By industrial stocks, we refer to small pelagic stocks used for fish meals and oil reduction

[10] For most of New Zealand stocks, including those harvested by the case studies fisheries investigated here, the fishing year "$n/n+1$" starts the 1st of October in year n and finishes the 30th of September in year $n+1$.

stock, a catching right (in kg) referred to as the annual catch entitlement (ACE), so that

$$\mathrm{ACE(kg)} = \mathrm{TACC(kg)} \times \mathrm{ITQ(\%)}$$

ACE, like ITQ, is freely tradable on the open market, and accessible to any New Zealand citizen. Despite that flexibility, and even where fishers are allowed to acquire catch rights after landing fish, aggregate commercial catches may not always match up with TACCs. Discarding is prohibited in New Zealand for almost all species managed under the QMS and, hence, cannot be considered as an option to balance catches. Fishers and/or quota-holders have two options. If the mismatch between catch and quota is limited, quota-holders are allowed to carry forward up to 10% of their quota. If that mismatch is greater, fishers are allowed to land species in excess of their ACE, even when the overall TACC for these species has already been exceeded. In that case, fishers are charged at the end of the fishing year a landing tax, or deemed value, for each unit of catch they land above their ACE holdings at the time. The deemed value is set annually by the Minister of Fisheries at the same time as the TAC and the TAC(C). There is no clear policy or rationale as to how the deemed value is calculated. However, the level at which the deemed value is set may have dramatic consequences for the fisheries sustainability. While a high deemed value (i.e. well above the ACE price) may encourage fishers to shift target species once their ACE is exceeded, a deemed value set at a low level (i.e. close to, and *a fortiori* below, the ACE price) may incentivise fishers to pay the charge requested and continue targeting the same stock, even when they have no ACE. For instance, the deemed value for hoki has been lower than the ACE price in 2007, and the TAC set for that stock was exceeded at the end of the fishing year.

Figures 1a-d shows the cumulated distributions over all QMS stocks of the percentage of catch over or under ACE, aggregated or not over all quota holders. For example, there are about 20% of QMS stocks for which the average individual quota holders' catch has exceeded their corresponding ACE (Figs. 1a,b). When we aggregate catches over all quota holders, however, there are only 10% of the QMS stocks for which the aggregated ACEs (which correspond to the TACC, plus possibly up to 10% carry-over from the previous year) have been exceeded (Figs. 1c,d). These trends are subject to little inter-annual fluctuations. The discrepancy between the aggregated and the individual-based figures may be explained by at least two mechanisms: (i) speculation from some quota holders who do not make all their quota available for leasing and (ii) a tendency of some fishers to accept to pay the deemed value rather than to buy ACEs as a result of (i) and of deemed values set too low by the Government. Indeed, Figure 1e suggests that the amount of deemed value reaches high levels for some key stocks (e.g. 3 million NZ dollars paid for hoki in 2004-2005 and 2005-2006). The quantity of deemed value paid is also subject to strong inter-annual variations, which depend to an important extent on the deemed value price, ACE price and availability.

6.3 Subsidies

In New Zealand there haven't been recently any economic incentives to encourage or restrict fishing effort. The number of fishing vessels has been reduced as a result of a rationalisation process initiated by the fishing companies in response to the quota reduction of some key species such as hoki.

In the EU, the Multi-Annual Guidance Programmes (MAGP) provided subsidies to accompany the decommissioning of fishing vessels (Nautilus 1997; Hatcher 2000; Frost and Kjærsgaard 2005). The decommissioning schemes mainly applied to vessels to be demolished, used for non-commercial fishing activities or transferred to non-EU countries. Although these decommissioning schemes ceased in 2004, subsidies are still a common feature of EU fisheries (Mesnil 2008).

7 Conservation performances

Comparing the sustainability of New Zealand and EU stocks is not a trivial task. First, only a minority of the commercially exploited stocks are subject to a full stock assessment, particularly in New Zealand. For the EU stocks and fisheries, the information on stock assessments, catch options, actual catch and TAC were mainly drawn from the 2007 ICES advisory reports (http://www.ices.dk/products/icesadvice.asp). Second, the triggers and standards used to assess the stock status are not necessarily consistent. In New Zealand, diagnostics are essentially based on a comparison between current and projected biomass and a reference biomass level producing the MSY. Depending on the stock being considered, the reference biomass is either a deterministic B_{MSY}, or one of its two usual stochastic variants: B_{MCY} or B_{MAY}. For the stocks assessed by ICES, there has been since 1998, and until recently, a tradition of assessing stocks in relation to B_{pa} and B_{lim}, and also fishing mortality in relation to F_{pa} and F_{lim}. In most cases, B_{pa} has been chosen as a level of biomass below which the risk of impaired recruitment is estimated to be high, or as the minimum historical observed level of biomass in the time series, and B_{pa} is generally lower than B_{MSY}. Third, there are stocks for which different stock trajectories are deemed plausible and for which available data do not enable to select one or the other trajectory.

For the purpose of this exercise, we have restricted our analysis to the stocks subject to at least one recent assessment. For the EU stock, we have considered only those stocks (i) subject to an ICES assessment (which excludes in particular large pelagics) and (ii) for which the EU is the major management agency (which excludes in particular North Sea saithe). We have used as sustainability indicator the frequency of estimated biomass exceeding the reference level(s), averaged over two different periods: 1987-1996 and 2002-2006. In some cases, different biomass estimates were deemed plausible and/or (in the case of New Zealand stocks) different reference biomass levels (i.e. deterministic B_{MSY}, stochastic B_{MCY} and/or B_{MAY}) were put forward for the same stock. In such situations, multiple sustainability indicators could be calculated, and we selected the lowest possible. B_{pa} was available and was chosen as the reference biomass level for all stocks fully assessed by

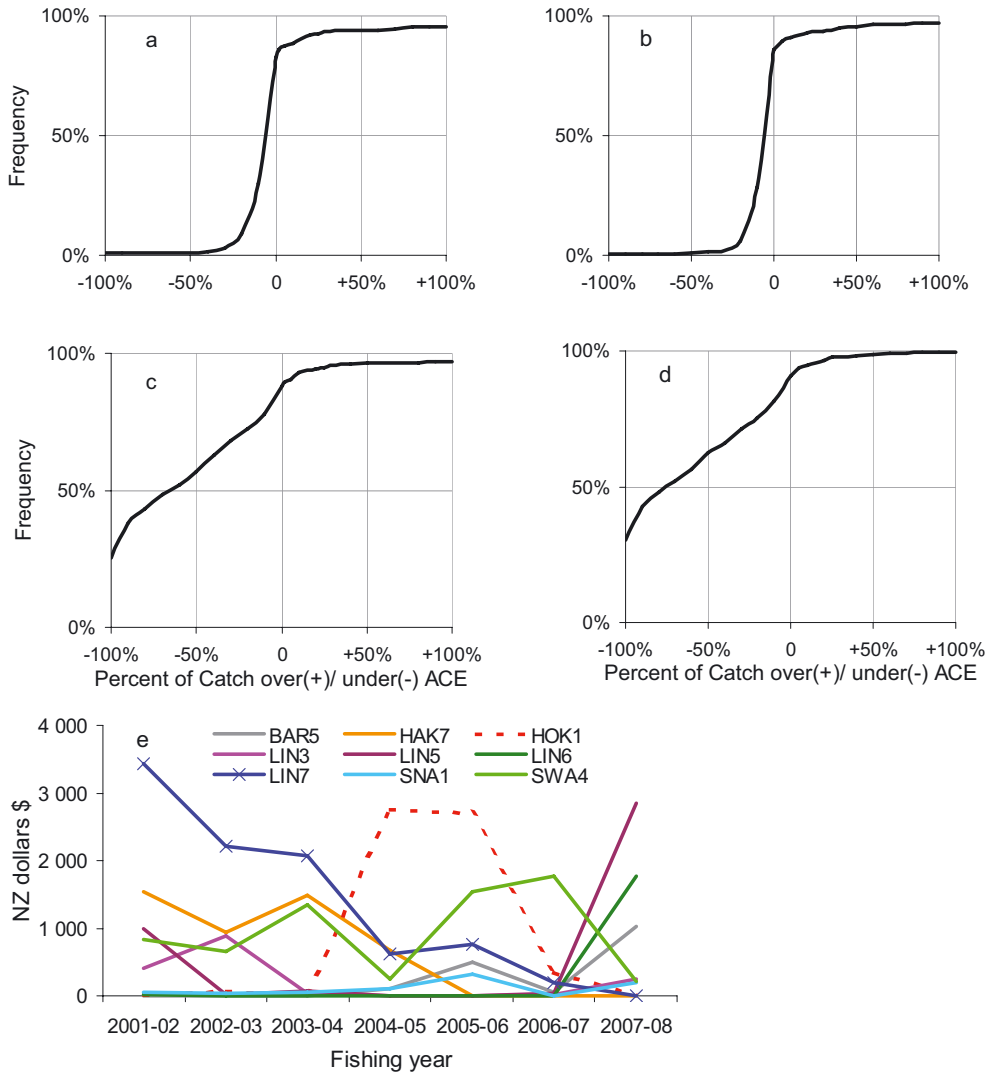

Fig. 1. Cumulated distribution over all quota management system, QMS, stocks of, (a, b) the average percentage of individual quota owners' catch over or under their corresponding ACE, (c, d) the percentage of total catch (aggregated over all quota holders) over or under the corresponding total ACE (aggregated over all quota holders, that is the TACC plus possibly up to 10% carry over from the previous fishing year), in fishing year (a, c) 2004-2005 and (b, d) 2006-2007; (e) deemed value paid by fishing year for important QMS stocks (BAR: barracouta, *Thyrsites atun*; HAK: hake, *Merluccius australis*; HOK: hoki, *Macruronus novaezelandiae*; LIN: ling, *Genypterus blacodes*; SNA: snapper, *Pagrus auratus*; SWA: silver warehou, *Seriollela punctata*).

ICES. On rare occasions, B_{pa} was not available and was substituted by B_{lim}.

Figure 2 shows the cumulated frequency of the sustainability index, averaged for all EU and New Zealand stocks over the periods 1987-1991 and 2002-2006.

In 1987-1991, the sustainability index was lower than 0.75 for 60% of the EU stocks and 30% of the New Zealand stocks. In 2002-2006, the sustainability index decreased for both EU and New Zealand stocks, but remained consistently higher for the New Zealand ones. Thus, the sustainability index was lower than 0.75 for 70% of the EU stocks and 50% of the New Zealand stocks during that period. Despite a decline in the most recent period, and considering that B_{MSY} is generally above B_{pa}, the New Zealand stocks subject to a stock assessment have probably been managed closer to sustainable levels than the EU stocks.

8 Conclusion and perspectives

The main similarities and contrasts between the EU and the New Zealand fisheries management systems are shown in Table 2.

Advisory processes in New Zealand and the European Union show a number of major differences. The systems that have evolved to deliver advice in New Zealand are generally more stock-specific, more inclusive, and less formalized than in Europe. The differences derive from the size of the systems, and consequent capacity and logistic considerations, and from different legislative bases. Neither system is necessarily better – the systems are different and are designed and have evolved to meet regional requirements.

New Zealand science processes are aimed at providing advice on only a limited number of stocks each year. TACs,

Table 2. Summary of the key similarities and differences of the fishery management systems in the EU and New Zealand.

		EU & New Zealand	EU	New Zealand
Processes	Science	Advisory process well established	Standardized quality control and outputs (ICES) Little involvement of stakeholders	Non-standardized quality control and outputs Broad involvement of stakeholders
	Operational policy	Stakeholders' involvement (RACs for the EU)	Requirement for annual TAC setting Costs of fisheries management and research recovered by tax payers	No requirement for annual TAC setting Costs of fisheries management and research mainly recovered by quota holders
	Decision-making	Precautionary principle	Several Fisheries Ministers Untransparent decisions Lobbying from stakeholders	One Fisheries Minister Documented decisions Formalized stakeholders' submissions
Objectives		Balance between sustainability and utilisation Precautionary principle	Explicit social objectives No legal target except in management plans Generally risk-averse	No explicit social objective B_{MSY} is the legal target for all QMS stocks Generally profit-maximising
Strategies			None until 1999. HCR provided through EU or multi-annual recovery/management plans	Generally constant TAC between (or if no) assessments, TAC update following assessments
Measures	Conservation	Output-based measures (TAC)	Input-based (technical measures, effort limits) Discarding tolerated	No input-based conservation measures Discarding banned
	Access regulation	Non-transferable fishing licenses/permits	No consistent pattern across member states for allocating TAC. IQ implicit in several countries Public subsidies (decommissioning schemes)	ITQ system implemented for all QMS stocks No public subsidies

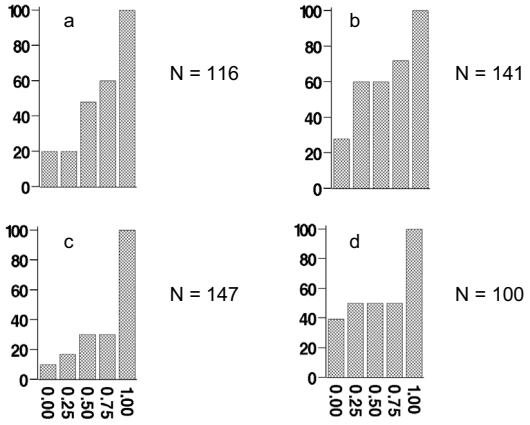

Fig. 2. Cumulated frequency (%) of the sustainability index, averaged for all (a, b) EU and (c, d) New Zealand stocks over the periods (a, c) 1987-1991 and (b, d) 2002-2006. For each combination of stock and year, the value of the sustainability index is 0 if the stock biomass (spawning or total depending on stocks) is below the reference level (B_{pa} for the EU stocks, B_{MSY} for the New Zealand stocks), and 1 otherwise.

which are almost exclusively the only conservation measure implemented to regulate New Zealand fisheries, are varied only if there is an obligation to do so, i.e. mainly when a stock is considered to be below the legislated target. In comparison, most TACs are reconsidered annually in the EU, and a wide range of technical (input) controls are promulgated. This difference in requirement, coupled with the generally much poorer state of European fisheries, creates different pressures on the science and policy processes to deliver relevant advice to decision-makers.

Science processes in ICES are funded by national governments and the European Commission. The cost of monitoring, assessment, provision of advice and associated research is hard to quantify but generally reckoned to be of the order of hundreds of millions of Euro per annum for about 100 stocks subject to a TAC constraint. In contrast, with costs in New Zealand primarily recovered from ITQ-holders, annual science-related costs amount to 10–15 million Euro for about 600 TAC stocks. With such differences in funding, it is inevitable that the nature and extent of the science processes are very different.

As far as scientific processes are concerned, quality control through internal and external scrutiny are features of both systems. The size of the New Zealand system in principle makes it easier to ensure controls, but performance is affected by the limitations in national capacity (including in financial resources). In contrast, the size of the ICES/European structure might make quality control and review difficult. However, excellent funding, large human resources, a long history and intense scrutiny have provided the basis for a highly controlled

and monitored system. The existence of a highly professional body (ICES) as a focus for the science processes is a benefit in this respect. Although very different in nature and extent, the two systems provide high quality and relevant outputs to the advisory process.

Stakeholder involvement in processes is a function of commitment and stake but also of logistics. In New Zealand, the ITQ system, return of commercial assets to Maori since 1992, strong recreational base and industry structures, have created the right environment for strong participation. Cost recovery of fisheries services has also created a strong desire to be included in processes and to optimize, in an economic sense, requests for scientific monitoring and advice. General administrative law and history of participatory political processes have created the context and incentives for all sectors to be involved. The size of the system and ease of communication all make participation logistically feasible. Taken together, New Zealand advisory processes could probably be qualified as participatory and in line with FAO recommendations on co-management (FAO 2007). What is more surprising, given the history of non-involvement and the logistic difficulties of creating participatory processes in a large multilateral decision-making framework, is the extent to which processes are becoming more inclusive and participatory in Europe. It will be interesting to see how the development of the RACs leads to changes in effective participation in coming years.

It should also be noted that the involvement of commercial stakeholders in the New Zealand fisheries management process is greatly encouraged by their financial contribution to processes underpinning management. In the EU, only the tax-payers generally support these costs. It could therefore be debated whether an increased involvement of EU stakeholders in the future should be accompanied by some form of cost-recovery regime.

The motivations of the decisions made by the European Council are not as transparent as in New Zealand. Another difference resides in the fact that, in Europe, the feedback from stakeholders has traditionally occurred through national lobbying rather than from coordinated and formal submission processes. However, efforts have been recently made towards more transparency in the stakeholders' involvement in decision-making, and the RACs in particular are expected to enhance that process in the future.

The concepts of profit-maximising targets and MSY are reasonably well accepted in New Zealand. An important challenge will be to remove the ambiguity around the legal definition of B_{MSY}, particularly for stocks where B_{MSY} cannot be calculated analytically. By contrast, there are a lot of ongoing debates in the EU around the definition of management targets. The newly implemented multi-annual recovery or management plans build on a variety of targets. These targets are reference levels of spawning biomass and/or fishing mortality, and build on a range of concepts including the PA approach, MSY and others. There are ongoing discussions around whether the level of biomass and/or of fishing mortality corresponding to the MSY should be used as a standard target for EU stocks and fisheries. While it is recognised that the MSY concept is advantageously simple and very important in fisheries management science, the ICES community has generally regarded it with a fair amount of skepticism, mainly because of the difficulties encountered in deriving reliable estimates. Although it is not clear which direction EU managers will choose in the future, it seems of relevance to the ongoing discussion that the EU has formally committed itself in 2002, during the Johannesburg World Summit on Sustainable Development, to restore fisheries to the MSY level by 2015.

No clear management strategies were implemented in the New Zealand fisheries until the inception of Harvest Strategy Standards in October 2008. The EU has moved since 1999 towards multi-annual fisheries management, starting with North Sea demersal stocks and now including a number of stocks in all waters under its jurisdiction. The effects of these multi-annual plans still remain to be fully evaluated, especially for the most recent ones, implemented following the 2002 reform of the CFP. Overall, both the EU and New Zealand seem to be moving in the right direction in formalising management strategies through, e.g., the elaboration of harvest control rules. There are, however, a number of technical issues, which need to be addressed before generalising the implementation of harvest control rules. These issues include: (i) the definition of rules and triggers for stocks not subject to stock assessments and (ii) the integration of technical interactions for stocks which are harvested simultaneously.

Consider the issue of rights-based management. There is an ongoing discussion as to whether or not the EU should move towards rights-based management and, if so, what the technical basis underlying that system would be. Quoting FAO (2007), "*there is worldwide recognition that the question of how to share limited fisheries resources must be addressed and that this means finding ways of determining who can catch what. These are sensitive decisions, but there is growing recognition in both the private and public sectors that the longer fishing communities and fisheries managers avoid allocating fishing rights, the greater the risk of making decisions that, ultimately, do not lead to fisheries that are as healthy or as sustainably utilized as they could be.*"

The Commission of the EU has recently opened a consultation on rights-based management in fisheries (EC 2007). In fact, rights-based management is already implicitly in place in Member States. ITQs are already up and running in The Netherlands and in Denmark, while in other countries quotas are exchanged between Producer Organisations and also across Member States. Quite plausibly, the implementation of a standard rights-based management system would formalise current market practices, and make them more transparent. *De facto*, the debate initiated by the Commission does not seem to be on whether, but rather on how rights-based management could be implemented within the highly administrative EU management system. We will review here some of the issues.

The first issue is that of the "relative stability" principle, which states that the key used to allocate TACs to each individual Member State cannot be altered from one year to the next. Implementing an ITQ system, or in fact any formal rights-based management regime, at a supranational scale, the European Union would need to revisit and possibly abolish the relative stability principle, and that would require a strong political move from the different Member States. However, as noted in Sect. 6.2, the "relative stability" principle is implicitly

broken when quotas are exchanged between Member States once the TAC has been allocated. In our view, reduction of the "relative stability" principle would therefore formalise current *ad hoc* practices.

The second issue is that transferring fishing rights may bring about excessive concentration. Even in the very liberal New Zealand ITQ system, that issue has been addressed administratively by generally limiting the quota concentration of each stock to 30%[11], so there should be at least three quota holders for each ITQ stock. A similar system could be adopted in the EU, with aggregation limits set to reflect EU social objectives. We note, however, work by Anderson (2008), which demonstrates that even highly aggregated rights do not generally lead to monopoly power as is often assumed.

The third issue concerns quota holding. New Zealand has adopted a liberal approach, where quota holding is dissociated from fishing activity. In other countries, ITQs are formally connected to the fishing sector, although that link may on some occasions be artificial. Although either system could be contemplated, dissociation of quota from the fishing activity would seem potentially to conflict with the CFP social objective, which shall *"ensure exploitation of living aquatic resources that provides sustainable economic, environmental and social conditions"* and also shall aim at "*providing a fair standard of living for those who depend on fishing activities*" (CFP 2002, Article 2.1). In particular, it may compromise the viability of small-scale fisheries and of the coastal communities that depend upon them. It is our opinion that if ITQs are implemented in the EU, there would likely be some restrictions as to who can hold them.

The fourth issue concerns the initial allocation of quotas. In fact, this is an issue the EU has been confronted with on several occasions: in 1983, when the CFP and the "relative stability" principle were established, and later, when new Member States were admitted to the EU and were allocated a fixed share of TACs. As for the New Zealand QMS, the approach pursued was to allocate quotas in proportion to a catch history. Although this is just one approach of many, it could be envisaged as a basis to determine the initial quota share. It is quite possible, building on both New Zealand's and EU's earlier experiences, that the initial quota allocation may not be free of tensions. However, it is also likely that any procedure aiming at allocating fishing rights would be contentious in the context of resource scarcity.

The fifth issue is catch-quota balancing. ITQs create individual incentives to avoid catch of species the fisher does not have quota for. However, in mixed-species ITQ fisheries, it is almost inevitable that fishers' species mix of catch will not exactly match their portfolio of catch rights. Even where fishers are allowed to acquire catch rights after landing fish, this can be problematic since aggregate catches may not match up with TAC levels. There are a number of alternative means to deal with this problem, including, *inter alia*: (i) discarding over-quota fish; (ii) allowing limited exchange of quota across species; (iii) allowing carry-over of a percentage of the quota from one year to another (shelving); (iv) requiring fishers to surrender catch they cannot cover with catch rights; (v) not allowing fishers to start a trip without sufficient quota to cover all potential catch or (vi) charging fishers a fee for each unit of catch they land without quota. Each of these options has pros and cons and all of these systems have been applied with mixed success in ITQ fisheries around the world. Discarding fish is the easiest but also least satisfactory way of achieving catch balancing. In New Zealand, where discarding is prohibited, options (iii) and (vi) have been implemented. A 10% carry-over of quota is permitted from one year to the next, otherwise a deemed value applies to every kg of fish landed over ACE. Adding flexibility to the "catch balancing regime" may increase the overall value generated by a complex of species in the short-run. However, added flexibility may also increase the risk that some species will be exploited to the point where their sustainable value is diminished and possibly their viability threatened.

A limitation of the New Zealand rights-based management system is the lack of a clear rationale or scientific basis supporting the setting of the deemed value. Deemed values were initially set as an institutional means of compensating some difficulties of balancing catches and discourage discarding. However, these have in recent years been used as an implicit fishing right by fishers who cannot find ACEs to cover their catch (availability issue) or have little interest in acquiring them (prices too high, including transaction costs) (Fig. 1). Our review suggests that EU resources are overall more depleted than in New Zealand. In that context, allowing EU fishers to exceed the TACs, which are often set above the ICES catch recommendations, may have more severe implications on the sustainability of fish stocks than in New Zealand. On the other hand, discarding practices are equally undesirable. Therefore, if the deemed value was to be considered in the EU as a tool to make catch-balancing more flexible, it would clearly need to be based, unlike in New Zealand, on scientific and economic evidence, and in any case set at a sufficiently high level to discourage targeting the stocks exploited beyond their biological limits. Of course, the use of economic tools such as deemed values would only be effective if supported by adequate enforcement tools. Other systems have been implemented to improve catch-quota balancing in mixed fisheries. In the British Columbia groundfish fishery, which is subject to ITQs, both reductions in discarding practices and improved catch balancing have been achieved by full observer coverage onboard fishing vessels (Branch et al. 2006). While this appears to be a success story, not all fisheries may necessarily be able to sustain the high monitoring costs required in the Canadian case.

The overall scope of this paper was to review some of the major features of two contrasted fisheries management systems. Our review has focused on conventional (mainly single-species) management aspects. However, it is worth noting that a number of steps have been initiated in both the EU and New Zealand towards an all-embracing ecosystem-based management.

In New Zealand, fisheries plans will ideally integrate fisheries management into broader ecosystem and marine environmental management. However, it has long been recognized that there is a need to clarify and generally streamline legislation and policy regarding oceans use in a broader sense,

[11] The Minister may nevertheless agree to waive this aggregation limit, which also does not apply to Maori ITQ ownership.

and to account for the impact of all human activities, not only fishing, on the marine ecosystem and environment. In 2000, an Oceans Policy programme was initiated but has foundered somewhat since then with differences of opinion as to direction and the need to take primarily legislative or policy routes. The Oceans Policy programme nevertheless remains on the Government agenda, and stakeholders are supportive of further work; it may yet provide an overarching framework for integrating fisheries and other marine resources and environmental management (Vince and Haward 2009).

The future of EU fisheries management is intrinsically linked with the setting of the all-embracing European Maritime Policy (EMP). The EMP recognises that ecosystems and the marine environment have been significantly affected by climate changes, but also by land- and sea-based human activities over the last decades. These activities include fisheries, but also maritime transport, coastal tourism, aquaculture, seabed exploitation, and sea-based renewable and conventional energy. The purpose of the EMP will be to deal with the cumulative impact of human activities on the oceans and seas, which is more than the sum of the impacts of different activities taken separately. This challenges the current governance framework of maritime affairs, which has tended to look at maritime activities separately. In parallel, ICES has evolved structurally to better grasp the challenge of giving ecosystem-based advice. Thus, advice related to fisheries, marine ecosystems and the marine environment was until recently provided by three separate Committees (ACFM, ACE, ACME). Within the new structure, ICES advice is now integrated in one single Advisory Committee: ACOM.

Quite plausibly, the consolidation of the full ecosystem-based management framework is likely to be a complex process. In fact, we may argue that a number of ecosystem-based management objectives could already be achieved by implementing conventional management measures in an effective way (Hilborn 2004; Mace 2004).

First, the move towards more participative processes and cost recovery is fully consistent with the ecosystem approach to fisheries, considering human beings as part of the ecosystem. While this move has been undertaken in New Zealand for a number of years, the Regional Advisory Councils established in 2002 by the EU Common Fisheries Policy are going in the right direction.

Second, achieving management targets for commercial species caught in mixed fisheries may be considered as an intermediate but important stage between the traditional single-species management that ignores technical interactions between fleets and species and a rather futuristic management system that would aim at achieving management targets for all the components of the ecosystem. Rights-based management (based on, e.g., ITQs), accompanied by appropriate incentives (e.g., high landing taxes associated to catches above quotas, discard ban or discount of discards against individual quotas with full observers coverage on-board fishing vessels) may be one way to achieve catch-quota balancing in the case of mixed fisheries, without revising fundamentally the single-species approach to TAC setting (Grafton et al. 2006). Alternatively, managers may account for technical interactions at the stage of TAC setting. This approach, however, would imply some extension of advice-giving beyond the scientific boundary into political territory. It would require in particular to prioritize management targets of some stocks in detriment of others, and also perhaps to specify explicitly the fleets, and possibly the countries, for which management action would be required in priority (Vinther et al. 2004; Reeves et al. 2008).

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ANNEX. Description of the management objectives and strategies applicable to the main EU fish stocks. IBSFC: International Baltic Sea Fisheries Commission, *TAC*: total allowable catch, SSB: spawning stock biomass (in tonnes), *F*: fishing mortality (in year^{-1}), *y*: the year, $B_{pa:}$ precautionary *SSB*, $B_{lim:}$ the limit SSB, F_{pa}: precautionary *F*, F_{MSY}: the *F* corresponding to the MSY (maximum sustainable yield), $F_{MA\ plan}$: the *F* corresponding to the multi-annual management plan. The species under consideration are: blue whiting (*Micromesistius poutassou*), cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), hake (*Merluccius merluccius*), Norway lobster (*Nephrops norvegicus*), herring (*Clupea harengus harengus*), mackerel (*Scomber scombrus*), plaice (*Pleuronectes platessa*), saithe (*Pollachius virens*) and sole (*Solea solea*).

Stock(s)	Plan type	Period	Trigger	Target	Basis	Test	*TAC* strategy
Blue whiting I-IX,XII,XIV	Coastal states multi-annual management	2002-2005	*SSB*	2.25 10^6	B_{pa}	NA	$F_{y+1} < 0.32$
	Coastal states multi-annual management	> 2006	*SSB* & *F*	2.25 10^6 & 0.32	B_{pa} & F_{pa}	$F_y > 0.32$	$TAC_{y+1} = TAC_y$–100 000
						$F_y < 0.32$	$F_{y+1} = 0.32$
						$SSB_{y+1} < B_{pa}$	Unspecified action
Cod IIIb-d (22-24)	IBSFC long-term management	2003-2005	*SSB*	23 000	B_{pa}	NA	$F < 1.0$ & $\lvert TAC_{y+1}–TAC_y\rvert / TAC_y < 15\%$
	EU multi-annual	> 2007	*F*	0.6	$F_{MA\ plan}$	$F_y > 0.60$	$F_{y+1} = 0.9\ F_y$ & $\lvert TAC_{y+1}–TAC_y\rvert / TAC_y < 15\%$
						$F_y < 0.60$	$F_{y+1} = 0.6$ & $\lvert TAC_{y+1}–TAC_y\rvert / TAC_y < 15\%$
Cod IIIb-d (25-32)	IBSFC long-term management	2003-2005	*SSB*	240 000	B_{pa}	NA	$F < 0.6$ & $\lvert TAC_{y+1}–TAC_y\rvert / TAC_y < 15\%$
	EU multi-annual	> 2007	*F*	0.3	$F_{MA\ plan}$	$F_y > 0.30$	$F_{y+1} = 0.9\ F_y$ & $\lvert TAC_{y+1}–TAC_y\rvert / TAC_y < 15\%$
						$F_y < 0.30$	$F_{y+1} = 0.3$ & $\lvert TAC_{y+1}–TAC_y\rvert / TAC_y < 15\%$
Cod IIIaS,IV,VIId	EU-Norway management	1999-2004	*SSB*	150 000	B_{pa}	NA	$F_{y+1} < 0.65$
	EU-Norway management	> 2005	*SSB*	150 000	B_{pa}	NA	$F_{y+1} < 0.40$ & $\lvert TAC_{y+1}–TAC_y\rvert / TAC_y < 15\%$
	EU recovery	> 2004	*SSB*	150 000	B_{pa}	$SSB_{y+1} < B_{pa}$	$SSB_{y+2} > 1.3\ SSB_{y+1}$ & $F_{y+1} < 0.65$ & $\lvert TAC_{y+1}–TAC_y\rvert / TAC_y < 15\%$
						$SSB_{y+1} > B_{pa}$	Review of the plan
Cod IIIaN	EU recovery	> 2004	*SSB*	10 500	B_{pa}	$SSB_{y+1} < B_{pa}$	$SSB_{y+2} > 1.3\ SSB_{y+1}$ & $F_{y+1} < 0.60$ & $\lvert TAC_{y+1}–TAC_y\rvert / TAC_y < 15\%$
						$SSB_{y+1} > B_{pa}$	Review of the plan
Cod VIa	EU recovery	> 2004	*SSB*	22 000	B_{pa}	$SSB_{y+1} < B_{pa}$	$SSB_{y+2} > 1.3\ SSB_{y+1}$ & $F_{y+1} < 0.60$ & $\lvert TAC_{y+1}–TAC_y\rvert / TAC_y < 15\%$
						$SSB_{y+1} > B_{pa}$	Review of the plan
Cod VIIa	EU recovery	> 2004	*SSB*	10 000	B_{pa}	$SSB_{y+1} < B_{pa}$	$SSB_{y+2} > 1.3\ SSB_{y+1}$ & $F_{y+1} < 0.72$ & $\lvert TAC_{y+1}–TAC_y\rvert / TAC_y < 15\%$
						$SSB_{y+1} > B_{pa}$	Review of the plan
Haddock IIIa,IV	EU-Norway management	1999-2006	*SSB*	140 000	B_{pa}	NA	$F_{y+1} < 0.70$
	EU-Norway management	> 2007	*SSB*	140 000	B_{pa}	$SSB_{y+1} < B_{lim}$	$F_{y+1} < 0.10$
						$B_{lim} < SSB_{y+1} < B_{pa}$	$F_{y+1} = 0.3$–$0.2(B_{pa}–SSB_{y+1})/(B_{pa}–B_{lim})$
						$SSB_{y+1} > B_{pa}$	$F_{y+1} < 0.30$ & $\lvert TAC_{y+1}–TAC_y\rvert / TAC_y < 15\%$

ANNEX. Continued.

Northern hake	EU recovery	> 2004	*SSB*	140 000	B_{pa}	$SSB_{y+1} < B_{pa}$	$F_{y+1} < 0.25$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
						$SSB_{y+1} > B_{pa}$	Review of the plan
Southern hake	EU combined recovery	> 2006	*SSB*	350 000	B_{pa}	$F_{y,hake} > 0.27$	$F_{y+1,hake} = 0.9\ F_{y,hake}$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
						$F_{y,hake} < 0.27$	$F_{y+1,hake} = 0.27$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
Norway lobster VIIIc	EU combined recovery	> 2006	NA	NA	NA	NA	$F_{y+1,nepVIIIc}/F_{y,nepVIIIc} = F_{y+1,hake}/F_{y,hake}$
Norway lobster IXa	EU combined recovery	> 2006	NA	NA	NA	NA	$F_{y+1,nepIXa}/F_{y,nepIXa} = F_{y+1,hake}/F_{y,hake}$
Herring IIIa,IV,VIId	EU-Norway management	2002-2004	*SSB*	$1.30\ 10^6$	B_{pa}	NA	$F_{0-1} < 0.12$ & $F_{2-6} < 0.25$
	EU-Norway management	> 2004	*SSB*	$1.30\ 10^6$	B_{pa}	$SSB_{y+1} < B_{lim}$	$F_{y+1,0-1} < 0.04$ $F_{y+1,2-6} < 0.10$
						$B_{lim} < SSB_{y+1} < B_{pa}$	$F_{y+1,0-1} = 0.12–0.08\ (B_{pa}–SSB_{y+1})/(B_{pa}–B_{lim})$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$ $F_{y+1,2-6} = 0.25–0.15(B_{pa}–SSB_{y+1})/(B_{pa}–B_{lim})$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
						$SSB_{y+1} > B_{pa}$	$F_{y+1,0-1} < 0.12$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$ $F_{y+1,2-6} < 0.25$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
Herring, spring spawning	Coastal states long-term management	> 1999	*SSB*	$5.00\ 10^6$	B_{pa}	$SSB_{y+1} < B_{pa}$	$0.05 < F_{y+1} < 0.125$ & $F_{y+1} < F_y$
						$SSB_{y+1} > B_{pa}$	Unspecified action
Mackerel, Northeast Atlantic	EU-Norway management	> 1999	*SSB*	$2.30\ 10^6$	B_{pa}	NA	$0.15 < F_{y+1} < 0.20$
Plaice IV	EU-Norway recovery/management	1999-2007	*SSB*	300 000	B_{pa}	NA	$F < 0.30$
	EU multi-annual management	> 2007	*F*	0.3	F_{MSY}	$F_{y,plaice} > 0.30$	$F_{y+1,plaice} = 0.9\ F_{y,plaice}$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
						$F_{y,plaice} < 0.30$	$F_{y+1,plaice} = 0.3$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
Saithe IIIa,IV,VI	EU-Norway management	1999-2004	*SSB*	200 000	B_{pa}	NA	$F < 0.40$
	EU-Norway management	> 2005	*SSB*	200 000	B_{pa}	$SSB_{y+1} < B_{lim}$	$F_{y+1} < 0.10$
						$B_{lim} < SSB_{y+1} < B_{pa}$	$F_{y+1} = 0.3–0.2\ (B_{pa}–SSB_{y+1})/(B_{pa}–B_{lim})$
						$SSB_{y+1} > B_{pa}$	$F_{y+1} < 0.30$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
Sole IV	EU multi-annual recovery/management	> 2007	*F*	0.2	F_{MSY}	$F_{y,sole} > 0.20$	$F_{y+1,sole} = 0.9\ F_{y,sole}$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
						$F_{y,sole} < 0.20$	$F_{y+1,sole} = 0.2$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
Sole VIIe	EU multi-annual recovery/management	> 2007	*F*	0.27	MA plan	$F_y > 0.27$	$F_{y+1} = 0.8\ F_y$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
						$F_y < 0.27$	$F_{y+1} = 0.27$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
Sole VIIIab	EU multi-annual management	> 2006	*SSB*	13 000	B_{pa}	$SSB_{y+1} < B_{pa}$	$F_{y+1} = 0.9\ F_y$ & $\lvert TAC_{y+1}-TAC_y\rvert / TAC_y < 15\%$
						$SSB_{y+1} > B_{pa}$	Review of the plan